

1    Claims.

2

3       1. A material which shatters, when broken, into  
4       fragments which do not cut, puncture or otherwise  
5       damage human skin or tissue, wherein the material is  
6       comprised of an amorphous thermoplastic polymer and  
7       one or more low molecular weight resins.

8

9       2. A material as claimed in Claim 1 comprised of a  
10       simple mixture of amorphous thermoplastic polymer  
11       and one or more low molecular resins.

12

13       3. A material as claimed in any one of the proceeding  
14       Claims wherein the amorphous thermoplastic polymer  
15       is selected from the group consisting of polystyrene  
16       (PS), polymethyl methacrylate (PMAA), styrene-  
17       acrylonitrile copolymer (SAN), linear polyesters and  
18       co-polyesters and polycarbonate (PC).

19

20       4. A material as claimed in any one of the proceeding  
21       claims having a tensile stress limit between 11 and  
22       60 Nmm<sup>-2</sup>.

23

24       5. A material as claimed in any one of the proceeding  
25       claims wherein the low molecular weight resin has an  
26       Mn (number average molecular weight) such that it  
27       has less than 500 repeating units.

28

29       6. A material as claimed in Claim 5 wherein the low  
30       molecular weight resin has an Mn (number average  
31       molecular weight) such that it has less than 50  
32       repeating units.

33

- 1       7. A material as claimed in any one of the proceeding  
2       claims manufactured in sheet form.  
3
- 4       8. A polymeric blend comprising a polymer selected from  
5       the group consisting of: polystyrene (PS),  
6       polymethyl methacrylate (PMAA), styrene-  
7       acrylonitrile copolymer (SAN), linear polyesters and  
8       co-polyesters and polycarbonate (PC) and one or more  
9       low molecular weight resins.  
10
- 11      9. A polymeric blend as claimed in Claim 8 wherein the  
12      one or more low molecular weight resins have an Mn  
13      (number average molecular weight) such that it has  
14      less than 500 repeating units.  
15
- 16      10. A polymeric blend as claimed in Claim 9 when in  
17      the one or more low molecular weight resins have an  
18      Mn (number average molecular weight) such that it  
19      has less than 50 repeating units.  
20
- 21      11. A polymeric blend as claimed in any one of Claims  
22      8 to 10 wherein the one or more molecular weight  
23      resins are hydrocarbon resins.  
24
- 25      12. A polymeric blend as claimed in Claim 11 wherein  
26      the hydrocarbon resins are aromatic hydrocarbon  
27      resins.  
28
- 29      13. A polymeric blend as claimed in any one of Claims  
30      8 to 12 manufactured in sheet form.  
31
- 32      14. A material which shatters, when broken, into  
33      fragments which do not cut, puncture or damage human  
34      skin or tissue, the material being comprised of

- 1 polystyrene and one or more low molecular weight  
2 resins.  
3
- 4 15. A material as claimed in Claim 14 comprised of a  
5 simple mixture of polystyrene and one or more low  
6 molecular weight resins.  
7
- 8 16. A material as claimed in any one of Claims 14 to  
9 15 wherein the one or more low molecular weight  
10 resins are hydrocarbon resins.  
11
- 12 17. A material as claimed Claim 16 wherein the  
13 hydrocarbon resins are aromatic hydrocarbon  
14 resins.  
15
- 16 18. A material as claimed in Claim 17 wherein the  
17 aromatic hydrocarbon resins are C9 aromatic  
18 hydrocarbon resins.  
19
- 20 19. A material as claimed in any one Claims 14 to 18  
21 wherein the one or more low molecular weight  
22 resins are, or are derived from, alpha methyl  
23 styrene.  
24
- 25 20. A material as claimed in any one of Claims 14 to  
26 19 wherein the one or more low molecular weight  
27 hydrocarbon resins are selected from a group  
28 consisting of; Norsolene™, Kristalex™, Plastolyn™,  
29 Endex™, Piccotex™, Piccolastic™, Sukorez™ or  
30 Arkon™.  
31
- 32 21. A material as claimed in Claim 20 wherein the one  
33 or more low molecular weight hydrocarbon resins  
34 are selected from a group consisting of;

1           Norsolene W90™, Norsolene W100™, Norsolene W110™,  
2           Kristalex F85™, Kristalex F100™, Kristalex F115™,  
3           Plastolyn 240™, Plastolyn 290™, Endex155™,  
4           Piccolastic D125™, Sukorez 100™, Sukorez 120™,  
5           Arkon P100™, Arkon P125™, Arkon P140™, Piccotex  
6           75™, Piccotex 100™ or Piccotex 120™.

7

8       22. A material as claimed in any one of Claims 14 to  
9           21 wherein the one or more low molecular weight  
10          resins have an Mn (number average molecular  
11          weight) such that it has less than 500 repeating  
12          units.

13

14       23. A material as claimed in Claim 22 wherein the one  
15          or more low molecular weight resins have an Mn  
16          (number average molecular weight) such that it has  
17          less than 50 repeating units

18

19       24. A material as claimed in any one of Claims 14 to  
20          23 having a tensile stress limit between 11 and 60  
21          Nmm<sup>-2</sup>.

22

23       25. A material as claimed in any one of Claims 14 to  
24          24 which also includes one or more additives  
25          selected from the group including UV inhibitors,  
26          antioxidants, flow modifiers, fire retarding  
27          agents, colour pigments and brighteners, and  
28          oxygen scavengers.

29

30       26. A material as claimed in any one of Claims 14 to  
31          25 manufactured in sheet form.

32

33       27. A method of manufacturing a material which  
34          shatters, when broken, into fragments which do not

- 1 cut, puncture or damage human skin or tissue, the  
2 method comprising the step of mixing an amorphous  
3 thermoplastic polymer and one or more low  
4 molecular weight resins.  
5
- 6 28. A material as claimed in Claim 27 wherein the  
7 amorphous thermoplastic polymer is chosen from the  
8 group consisting of polystyrene (PS),  
9 Polymethyl methacrylate (PMAA), styrene-  
10 acrylonitrile copolymer (SAN), linear polyesters  
11 and co-polyesters polycarbonate (PC).  
12
- 13 29. A material as claimed in any one of Claims 27 to  
14 28 wherein the one or more low molecular weight  
15 resins are hydrocarbon resins.  
16
- 17 30. A material as claimed in Claim 29 wherein the  
18 hydrocarbon resins are aromatic hydrocarbon  
19 resins.  
20
- 21 31. A material as claimed in any one of Claims 27 to  
22 30 wherein the low molecular weight resin has an  
23 Mn (number average molecular weight) such that it  
24 has less than 500 repeating units.  
25
- 26 32. A material as claimed in Claim 31 wherein the low  
27 molecular weight resin has an Mn (number average  
28 molecular weight) such that it has less than 50  
29 repeating units.  
30
- 31 33. A material as claimed in any one Claims 27 to 37  
32 wherein the glass transition temperature ( $T_g$ ) of  
33 the material is elevated as the amorphous

- 1 thermoplastic polymer is mixed with the one or  
2 more low molecular weight hydrocarbon resins.  
3
- 4 34. A material as claimed in Claim 33 when the T<sub>g</sub> is  
5 elevated to 5-10°C higher than the base polymer.  
6
- 7 35. A method of manufacturing a material which  
8 shatters, when broken, into fragments which do not  
9 cut, puncture or damage human skin or tissue, the  
10 methods comprising the step of mixing polystyrene  
11 and one or more low molecular weight hydrocarbon  
12 resins.  
13
- 14 36. A method as claimed in Claim 35 wherein the one or  
15 more low molecular weight resins are hydrocarbon  
16 resins.  
17
- 18 37. A method as claimed in Claim 36 wherein the  
19 hydrocarbon resins are aromatic hydrocarbon  
20 resins.  
21
- 22 38. A method as claimed in Claim 36 wherein the  
23 aromatic hydrocarbon resins are C<sub>9</sub> aromatic  
24 hydrocarbon resins.  
25
- 26 39. A method as claimed in any one of Claims 35 to 38  
27 wherein the one or more low molecular weight  
28 resins are, or are derived from, alpha methyl  
29 styrene.  
30
- 31 40. A method as claimed in any one of Claims 35 to 39  
32 wherein the one or more low molecular weight  
33 hydrocarbon resins are selected from a group  
34 consisting of; Norsolene™, Kristalex™, Plastolyn™,

1           Endex™, Piccotex™, Piccolastic™, Sukorez™ or  
2           Arkon™.

3  
4       41. A method as claimed in Claim 40 wherein the one or  
5       more low molecular weight hydrocarbon resins are  
6       selected from a group consisting of Norsolene  
7       W90™, Norsolene W100™, Norsolene W110™, Kristalex  
8       F85™, Kristalex F100™, Kristalex F115™, Plastolyn  
9       240™, Plastolyn 290™, Endex155™, Piccolastic  
10       D125™, Sukorez 100™, Sukorez 120™, Arkon P100™,  
11       Arkon P125™, Arkon P140™, Piccotex 75™, Piccotex  
12       100™ or Piccotex 120™.

13  
14       42. A method as claimed as in any one of Claims 35 to  
15       41 wherein the low molecular weight resin has an  
16       Mn (number average molecular weight) such that it  
17       has less than 500 repeating units.

18  
19       43. A method as claimed in Claim 42 wherein the low  
20       molecular weight resin has an Mn (number average  
21       molecular weight) such that it has less than 50  
22       repeating units.

23  
24       44. A method as claimed in any one of Claims 35 to 43  
25       comprising the additional step of adding one or  
26       more additives selected from the group consisting  
27       of UV inhibitors, antioxidants, flow modifiers,  
28       fire retarding agents, colour pigments and  
29       brighteners and oxygen scavengers as known in the  
30       art.

31  
32       45. A method as claimed in any one of Claims 35 to 44  
33       where the glass transition temperature (T<sub>g</sub>) of the  
34       material is elevated as the polystyrene is mixed

1           with one or more low molecular weight hydrocarbon  
2           resins.

3

4       46. A method as claimed in Claim 45 wherein the T<sub>g</sub> is  
5           elevated to 5 to 10°C higher than the base  
6           polymer.

7

8       47. A container manufactured from a material that  
9           shatters when broken into fragments which do not  
10          cut, puncture or otherwise damage human skin or  
11          tissue.

12

13      48. A container as claimed in Claim 47 which is a  
14          bottle.

15

16      49. A container as claimed in Claim 47 which is a  
17          glass.

18

19      50. A container as claimed in Claim 47 which is a  
20          tumbler.

21

22      51. A container as claimed in any one of Claims 47 to  
23           50 wherein the material is a mixture of an  
24           amorphous thermoplastic polymer and one or more  
25           low molecular weight resins.

26

27      52. A container as claimed in Claim 51 wherein the  
28           amorphous thermoplastic polymer is chosen from the  
29           group consisting of: polystyrene (PS), styrene-  
30           acrylonitrile co-polymer (SAN), linear polyesters  
31           and co-polyesters polycarbonate (PC).

32



- 1        53. A container as claimed in Claim 51 wherein the one  
2            or more low molecular weight resins are  
3            hydrocarbon resins.  
4
- 5        54. A container as claimed in A container as claimed  
6            in Claim 53 wherein the one or more low molecular  
7            weight resins are aromatic hydrocarbon resins  
8
- 9        55. A container as claimed in Claims 53 to 54 wherein  
10           the one or more low molecular weight hydrocarbon  
11           resins are selected from a group consisting of:  
12           Norsolene™, Krystalex™, Plastolyn™, Endex™,  
13           Piccotex™, Piccolastic™, Sukorez™, Arkon™  
14
- 15       56. A container as claimed in Claim 55 wherein the one  
16           or more low molecular weight hydrocarbon resins  
17           are selected from a group consisting of: Norsolene  
18           W90™, Norsolene W100™, Norsolene W110™, Kristalex  
19           F85™, Kristalex F100™, Kristalex F115™,  
20           Plastolyn 240™, Plastolyn 290™, Endex 155™,  
21           Piccolastic D125™, Sukorez 100™, Sukorez 120™,  
22           Arkon P100™, Arkon P125™, Arkon P140™, Piccotex  
23           75™, Piccotex 100™ or Piccotex 120™.  
24
- 25       57. A container as claimed in any one of Claims 51 to  
26           56 wherein the low molecular weight resin will  
27           have a  $\overline{M}_n$  (number average molecular weight) such  
28           that it has less than 500 repeating units.  
29
- 30       58. A container as claimed in any one of Claims 51 to  
31           56 wherein the low molecular weight resin will  
32           have a  $\overline{M}_n$  (number average molecular weight) such  
33           that it has less than 50 repeating units.

- 1  
2 59. A container as claimed in any one of Claims 47 to  
3 58 wherein the material has a tensile stress limit  
4 between 11 and 60 Nmm<sup>-2</sup>.  
5  
6 60. A container as claimed in any one of Claims 47 to  
7 59 manufactured using injection blow moulding  
8 and/or injection stretch blow moulding  
9 techniques.  
10  
11 61. A container as claimed in any one of Claims 47 to  
12 59 manufactured using extrusion blow moulding.  
13  
14 62. A container as claimed in any one of Claims 47 to  
15 61 wherein the material contains an oxygen  
16 barrier.  
17  
18 63. A container as claimed in Claim 62 wherein the  
19 barrier included in the material is selected from  
20 the group consisting of: acrylonitrile-methyl  
21 acrylate copolymer, ethylene vinyl alcohol (EVOH)  
22 or nylon MXD6.  
23  
24 64. A container as claimed in Claim 62 wherein the  
25 barrier is Barex™.  
26  
27 65. A container as claimed in Claim 64 wherein the  
28 barrier is Barex™ 210 or Barex™ 218.  
29  
30 66. A container as claimed in any one of Claims 62 to  
31 65 wherein the barrier is overmoulded or sprayed  
32 onto the container.  
33

- 1       67. A container as claimed in any one of Claims 62 to  
2           65 wherein the barrier is mixed with the material  
3           of the container, using co-injection techniques.  
4
- 5       68. A container as claimed in any one of Claims 47 to  
6           67 wherein the material contains one or more  
7           oxygen scavengers.  
8
- 9       69. A container as claimed in Claim 68 wherein the  
10          oxygen scavenger is selected from a group  
11          consisting of X-312, Amosorb 3000, or a scavenger  
12          of MXD6 with metal catalysed oxygen reduction  
13          chemistry.  
14
- 15      70. A container as claimed in any one of Claims 47 to  
16          69 having an inorganic coating.  
17
- 18      71. A container as claimed in Claim 70 wherein the  
19          inorganic layer is a thin layer of amorphous  
20          carbon.  
21
- 22      72. A container as claimed in Claims 70 to 71 wherein  
23          the inorganic coating is applied to the inside  
24          surface of the container.  
25
- 26      73. A container as claimed in any one of Claims 70 to  
27          72 wherein the inorganic coating will be applied  
28          in a layer of 100 to 200nm thickness.  
29
- 30      74. A container as claimed in any one of Claims 47 to  
31          73 having an external organic coating.  
32

- 1        75. A container as claimed in Claim 74 wherein the  
2            external organic coating is PVDC or a two  
3            component epoxyamine.  
4
- 5        76. A container as claimed in any one of Claims 47 to  
6            75 manufactured from multiple layers of the  
7            material.  
8
- 9        77. A container as claimed in any one of Claims 47 to  
10            76 wherein the material includes one or additives  
11            selected from the group consisting of UV  
12            inhibitors, antioxidants, flow modifiers, colour  
13            pigments and brighteners as known in the art.  
14
- 15       78. A container as claimed in any one of Claims 51 to  
16            77 wherein the glass transition temperature is  
17            elevated as the amorphous thermoplastic polymer is  
18            mixed with the one or more low molecular weight  
19            hydrocarbons.  
20
- 21       79. A container as claimed in any one of Claims 51 to  
22            78 wherein the material has a glass transition  
23            temperature of above 80°C.